TEST REPORT

Report No.: SHATBL2310007W03

Applicant	:	HuiZhou WanZhiSheng New Energy Technology CO.,LTD
Product Name	:	Bluetooth voice remote control
Brand Name	:	N/A
Model Name	:	RC-36
FCC ID	:	2BDAL-RC-36
Test Standard	:	47 CFR 15.247
Date of Test	:	2023.10.16-2023.10.19

Report Prepared by : (Jack Suo)

Report Approved by : (Ghost Li)

Authorized Signatory : (Terry Yang)

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REVISION HISTORY

Rev.	Issue Date	Revisions	Revised by
00	2023.07.20	Initial Release	Ghost Li

DECLARATION OF REPORT

1. The device has been tested by ATBL, and the test results show that the equipment under test (EUT) is in compliance with the requirements of 47 CFR 15.247. And it is applicable only to the tested sample identified in the report.

2. This report shall not be reproduced except in full, without the written approval of ATBL, this document only be altered or revised by ATBL, personal only, and shall be noted in the revision of the document.

3. The general information of EUT in this report is provided by the customer or manufacture, ATBL is only responsible for the test data but not for the information provided by the customer or manufacture.

4. The results in this report is only apply to the sample as tested under conditions. The customer or manufacturer is responsible for ensuring that the additional production units of this model have the same electrical and mechanical components.

5. In this report, '☐' indicates that EUT does not support content after '☐', and '☑' indicates that it supports content after '☑'

SUMMARY OF TEST RESULT

Report Section	Standard Section	Test Item	Judgment	Remark
3.1	47 CFR 15.247(b)(3)	Maximum Peak Conducted Output Power	PASS	--
3.2	--	Duty Cycle	Report only	--
3.3	47 CFR 15.247(a)(2)	6dB Bandwidth	PASS	--
	--	99% Bandwidth	Report only	--
3.4	47 CFR 15.247(e)	Power Spectral Density	PASS	--
3.5	47 CFR 15.247(d)	Conducted Band Edge	PASS	--
3.6	47 CFR 15.247(d)	Conducted Spurious Emission	PASS	--
3.7	47 CFR 15.247(d)/15.209(a)/15.205(a)	Radiated Spurious Emission and Restricted Band	PASS	--
3.8	47 CFR 15.207(a)	AC Power-Line Conducted Emission	PASS	--
3.9	47 CFR 15.203	Antenna Requirements	PASS	--

1. GENERAL DESCRIPTION

1.1. Applicant

Name	:	HuiZhou WanZhiSheng New Energy Technology CO.,LTD
Address	:	2-3F, 1st Workshop (Jingtai Group), 51 Dongxin Ave, Dongjiang Tech Park, Huicheng, Huizhou, China

1.2. Manufacturer

Name	:	HuiZhou WanZhiSheng New Energy Technology CO.,LTD
Address	:	2-3F, 1st Workshop (Jingtai Group), 51 Dongxin Ave, Dongjiang Tech Park, Huicheng, Huizhou, China

1.3. Factory

Name	:	HuiZhou WanZhiSheng New Energy Technology CO.,LTD
Address	:	2-3F, 1st Workshop (Jingtai Group), 51 Dongxin Ave, Dongjiang Tech Park, Huicheng, Huizhou, China

1.4. General Information of EUT

General Information	
Equipment Name	Bluetooth voice remote control
Brand Name	N/A
Model Name	RC-36
Series Model	N/A
Model Difference	N/A
SN or IMEI Code	20230802001002
Power Input	DC 3V
Hardware Version	V1.0
Software Version	V0.0.4
Connecting I/O Port(s)	Refer to the remark below.

Remark:

The above information of EUT was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.5. Equipment Specification

Equipment Specification		
Frequency Range	2400MHz - 2483.5MHz	
Number of Channels	40	
Carrier Frequency of Each Channel	2402 + n*2 MHz; n = 0 ~ 39	
Maximum Output Power To Antenna	☑Bluetooth LE(1Mbps):	1.38dBm (0.001374W)
	☐Bluetooth LE(2Mbps):	dBm (W)
Type of Modulation	Bluetooth LE:	GFSK
Antenna Type	Onboard antenna	
Antenna Gain	1.8128dBi	

1.6. Modification of EUT

No modifications are made to the EUT during all test items.

1.7. Laboratory Information

Company Name :	Shanghai ATBL Technology Co., Ltd.
Address :	Building 8,No.160 Basheng Road, Waigaoqiao Free Trade Zone, Pudong New Area, Shanghai
Telephone :	+86(0)21-51298625

1.8. Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

47 CFR Part 15 Subpart C §15.247

FCC KDB 558074 D01 15.247 Meas Guidance v05r02

ANSI C63.10-2013

Remark:

All test items were verified and recorded according to the standards and without any deviation during the test.

2. TEST CONFIGURATION OF EUT

2.1. Carrier Frequency Channel

Frequency Band	Channel	Frequency MHz	Channel	Frequency MHz	Channel	Frequency MHz
2400 - 2483.5 MHz	**00**	**2402**	14	2430	28	2458
	01	2404	15	2432	29	2460
	02	2406	16	2434	30	2462
	03	2408	17	2436	31	2464
	04	2410	18	2438	32	2466
	05	2412	**19**	**2440**	33	2468
	06	2414	20	2442	34	2470
	07	2416	21	2444	35	2472
	08	2418	22	2446	36	2474
	09	2420	23	2448	37	2476
	10	2422	24	2450	38	2478
	11	2424	25	2452	**39**	**2480**
	12	2426	26	2454	--	--
	13	2428	27	2456	--	--

Remark:

Low Channel: **CH 00_2402 MHz**; Middle Channel: **CH 19_2440 MHz**; High Channel: **CH 39_2480 MHz**.

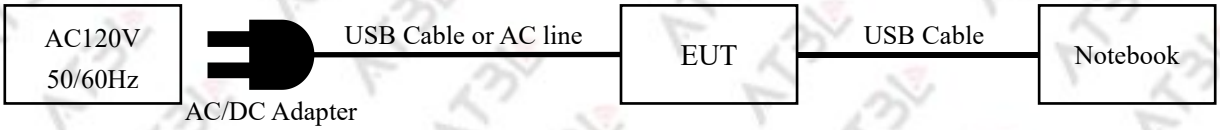
2.2. Test Modes

The table below is showing all test modes to demonstrate in compliance with the standard.

Summary Table of Test Modes		
Test Item	Data Rate / Modulation	
	☑Bluetooth LE(1Mbps)	☐Bluetooth LE(2Mbps)
For Conducted and Radiated Test	Mode 1: CH00_2402 MHz	Mode 4: CH00_2402 MHz
	Mode 2: CH19_2440 MHz	Mode 5: CH19_2440 MHz
	Mode 3: CH39_2480 MHz	Mode 6: CH39_2480 MHz
For AC Power-line Conducted Emission	Mode 7: Keep Bluetooth link under the maximum output power	

2.3. Block Diagram of Test System

2.3.1. For AC Power-Line Conducted Emission



2.3.2. For Radiated Spurious Emission

2.3.3. For Conducted Test

2.4. Description of Support Units

NO.	Unit	Brand	Model	Description
1	Notebook	Lenovo	DESKTOP-USDEO09	N/A
2	USB Cable	N/A	100cm	N/A

2.5. Test Software and Power Level

During the test, the channel and power control software provided by the customer is used to control the operation channel and output power level.

2.6. EUT Operating Conditions

For AC power-line conducted emission, the EUT was connected under the large package sizes transmission.

For radiated spurious emission and conducted test, the engineering test program was provided and make the EUT to continuous transmit/receive.

2.7. Equipment List

2.7.1. For AC Power-Line Conducted Emission

Equipment Name	Manufacturer	Model	Serial No.	Equipment No.	Calibration Until
Test Receiver	R&S	ESPI	101679	SHATBL-E012	2024.07.09
LISN	R&S	ENV216	100300	SHATBL-E013	2024.07.09
LISN	R&S	ENV216	100333	SHATBL-E041	2024.07.09
Thermometer	DeLi	N/A	N/A	SHATBL-E016	2024.07.09
Test Software	FALA	EZ-EMC	N/A	SHATBL-E046	N/A

2.7.2. For Radiated Spurious Emission

Equipment Name	Manufacturer	Model	Serial No.	Equipment No.	Calibration Until
Signal analyzer	Agilent	N9020A	MY50200811	SHATBL-E017	2024.07.09
Amplifier	JPT	JPA0118-55-303A	1910001800055000	SHATBL-E006	2024.07.09
Amplifier	JPT	JPA-10M1G32	21010100035001	SHATBL-E005	2024.07.09
Antenna/Turn table Controller	Brilliant	N/A	N/A	SHATBL-E007	N/A
Loop Antenna	Daze	ZN30900C	20077	SHATBL-E042	2024.07.09
Bilog Antenna	SCHWARZBECK	VULB 9168	01174	SHATBL-E008	2024.07.09
Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120D	02334	SHATBL-E009	2024.07.09
Horn Antenna	COM-POWER	AH-1840	10100008	SHATBL-E043	2024.07.09
Thermometer	DeLi	N/A	N/A	SHATBL-E015	2024.07.09
Test Software	FALA	EMC-RI	N/A	SHATBL-E046	N/A

2.7.3. For Conducted Test

Equipment Name	Manufacturer	Model	Serial No.	Equipment No.	Calibration Until
Power meter	Anritsu	ML2496A	1935001	SHATBL-W030	2024.07.09
Power sensor	Anritsu	MA2411B	1911006	SHATBL-W031	2024.07.09
Power sensor	DARE	RPR3006W	16I00054SN016	SHATBL-W008	2024.07.09
Power sensor	DARE	RPR3006W	RPR6W-2001005	SHATBL-W032	2024.07.09
Power sensor	Rediteq	RPR3006W	RPR6W-2201002	SHATBL-W033	2024.07.09
Power sensor	Rediteq	RPR3006W	RPR6W-2201003	SHATBL-W034	2024.07.09
Power sensor	Keysight	U2021XA	MY59120004	SHATBL-W035	2024.07.09
Adjustable Attenuator	Agilent	8494B	MY42144015	SHATBL-W009	2024.07.09
Adjustable Attenuator	Agilent	8496B	MY42143776	SHATBL-W010	2024.07.09
Environmental Test Chamber	KSON	THS-B6C-150	9159K	SHATBL-W019	2024.07.09
Signal analyzer	Keysight	N9020A	MY50510136	SHATBL-W003	2024.07.09
Vector signal generator	Keysight	N5182B	MY57300196	SHATBL-W005	2024.07.09
Vector signal generator	Agilent	N5182A	MY50143555	SHATBL-W037	2024.07.09
Analog signal generator	Keysight	N5173B	MY60403026	SHATBL-W038	2024.07.09
Wideband radio communication tester	R&S	CMW500	101331	SHATBL-W007	2024.07.09
Spectrum analyzer	R&S	FSV40-N	101761	SHATBL-W036	2024.07.09
Switch Box	N/A	RFSW3003328	RFSW201019	SHATBL-W029	N/A
Thermometer	DeLi	N/A	N/A	SHATBL-W012	2024.01.16
Test Software	FALA	LZ-RF	N/A	SHATBL-W020	N/A

2.8. Measurement Uncertainty

The reported uncertainty of measurement y±U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95 %.

No.	Item	Uncertainty
1	RF output power, conducted	±0.958dB
2	Conducted spurious emissions	±2.988dB
3	All emissions, radiated 30MHz-1GHz	±2.50dB
4	All emissions, radiated 1GHz-18GHz	±3.51dB
5	Occupied bandwidth	±23.20Hz
6	Power spectral density	±0.886dB

3. TEST RESULT

3.1. Maximum Peak Conducted Output Power

3.1.1. Limit

47 CFR 15.247(b)(3): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

47 CFR 15.247(b)(4): If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

47 CFR 15.247(c)(1)(i): Systems operating in the 2400−2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

3.1.2. Test Procedure

ANSI C63.10-2013 clause 11.9.1.3 PKPM1 Peak power meter method: The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall use a fast-responding diode detector.

ANSI C63.10-2013 clause 11.9.2.3.1 Method AVGPM: Method AVGPM is a measurement using an RF average power meter, as follows:

1. As an alternative to spectrum analyzer or EMI receiver measurements, measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied:

① The EUT is configured to transmit continuously, or to transmit with a constant duty cycle.

② At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.

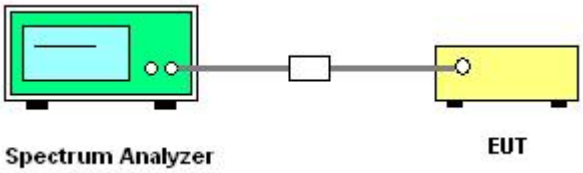
③ The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.

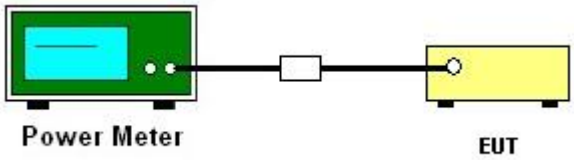
2. If the transmitter does not transmit continuously, measure the duty cycle, D, of the transmitter output signal as described in *ANSI C63.10-2013 clause 11.6*.

3. Measure the average power of the transmitter. This measurement is an average over both the ON and OFF periods of the transmitter.

4. Adjust the measurement in dBm by adding [10 log (1 / D)], where D is the duty cycle.

3.1.3. Test Setup





3.1.4. Test Result of Maximum Peak Conducted Output Power

Please refer to the Appendix A.

3.2. Duty Cycle

3.2.1. Limit

There is no limit requirement for Duty Cycle.

3.2.2. Test Procedure

ANSI C63.10-2013 clause 11.6: Measurements of duty cycle and transmission duration shall be performed using one of the following techniques:

1. A diode detector and an oscilloscope that together have a sufficiently short response time to permit accurate measurements of the ON and OFF times of the transmitted signal.

2. The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the ON and OFF times of the transmitted signal:

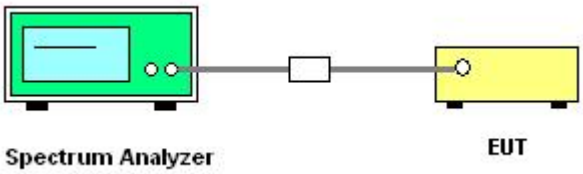
① Set the center frequency of the instrument to the center frequency of the transmission.

② Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value.

③ Set VBW ≥ RBW. Set detector = peak or average.

④ The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring the duty cycle shall not be used if T ≤ 16.7 μs.)

3.2.3. Test Setup



3.2.4. Test Result of Duty Cycle

Please refer to the Appendix A.

3.3. 6dB Bandwidth and 99% Bandwidth

3.3.1. Limit

47 CFR 15.247(a)(2): Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

There is no limit requirement for 99% Bandwidth.

3.3.2. Test Procedure

1. The testing of 6dB Bandwidth follows *ANSI C63.10-2013 clause 11.8.1*: The steps for the first option are as follows:

① Set RBW = 100 kHz.

② Set the VBW ≥ [3 × RBW].

③ Detector = peak.

④ Trace mode = max hold.

⑤ Sweep = auto couple.

⑥ Allow the trace to stabilize.

⑦ Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

2. The testing of 99% Bandwidth follows *ANSI C63.10-2013 clause 6.9.3*: The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:

① The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.

② The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.

③ Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in *ANSI C63.10-2013 clause 4.1.5.2*.

④ Step a) through step c) might require iteration to adjust within the specified range.

⑤ Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.

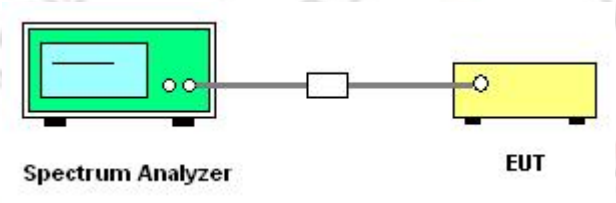
⑥ Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

⑦ If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at

the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.

⑧ The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

3.3.3. Test Setup



3.3.4. Test Result of 6dB Bandwidth and 99% Bandwidth

Please refer to the Appendix A.

3.4. Power Spectral Density

3.4.1. Limit

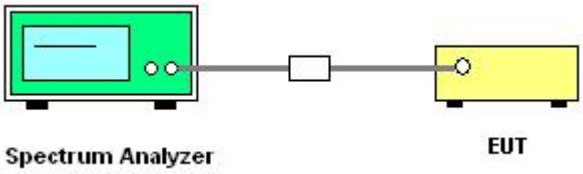
47 CFR 15.247(e): For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

3.4.2. Test Procedure

ANSI C63.10-2013 clause 11.10.2: The following procedure shall be used if maximum peak conducted output power was used to determine compliance, and it is optional if the maximum conducted (average) output power was used to determine compliance:

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to 3 kHz.
4. Set the VBW ≥ [3 × RBW].
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.

3.4.3. Test Setup



3.4.4. Test Result of Power Spectral Density

Please refer to the Appendix A.

3.5. Conducted Band Edge

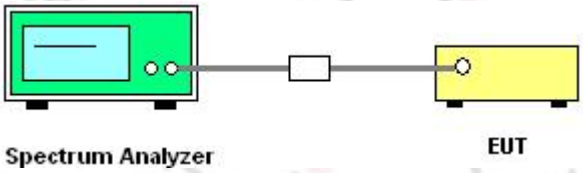
3.5.1. Limit

47 CFR 15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

3.5.2. Test Procedure

1. The testing follows *ANSI C63.10-2013 clause 11.13*.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Conducted Band Edge measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the 100 kHz bandwidth within the band that contains the highest level of the desired power when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
4. Measure and record the results in the test report.
5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.5.3. Test Setup



3.5.4. Test Result of Conducted Band Edge

Please refer to the Appendix A.

3.6. Conducted Spurious Emission

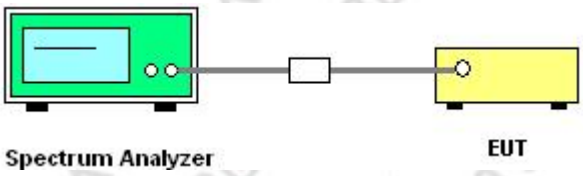
3.6.1. Limit

47 CFR 15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

3.6.2. Test Procedure

1. The testing follows *ANSI C63.10-2013 clause 7.8.8*.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.6.3. Test Setup



3.6.4. Test Result of Conducted Spurious Emission

Please refer to the Appendix A.

3.7. Radiated Spurious Emission and Restricted Band

3.7.1. Limit

47 CFR 15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

47 CFR 15.205(a): Only spurious emissions are permitted in any of the frequency bands listed below:

Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
0.090-0.110	12.29-12.293	149.9-150.05	1660-1710	8.025-8.5
0.495-0.505	12.51975-12.52025	156.52475-156.52525	1718.8-1722.2	9.0-9.2
2.1735-2.1905	12.57675-12.57725	156.7-156.9	2200-2300	9.3-9.5
4.125-4.128	13.36-13.41	162.0125-167.17	2310-2390	10.6-12.7
4.17725-4.17775	16.42-16.423	167.72-173.2	2483.5-2500	13.25-13.4
4.20725-4.20775	16.69475-16.69525	240-285	2690-2900	14.47-14.5
6.215-6.218	16.80425-16.80475	322-335.4	3260-3267	15.35-16.2
6.26775-6.26825	25.5-25.67	399.9-410	3332-3339	17.7-21.4
6.31175-6.31225	37.5-38.25	608-614	3345.8-3358	22.01-23.12
8.291-8.294	73-74.6	960-1240	3600-4400	23.6-24.0
8.362-8.366	74.8-75.2	1300-1427	4500-5150	31.2-31.8
8.37625-8.38675	108-121.94	1435-1626.5	5350-5460	36.43-36.5
8.41425-8.41475	123-138	1645.5-1646.5	7250-7750	Above 38.6

47 CFR 15.209(a): The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

3.7.2. Test Procedure

1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Pre-amp Factor = Level.
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
8. Use the following spectrum analyzer settings:

① Span shall wide enough to fully capture the emission being measured;

② When frequency < 1 GHz:

• Set RBW=100 kHz; VBW ⩾ RBW; Sweep = auto; Detector function = peak; Trace = max hold;

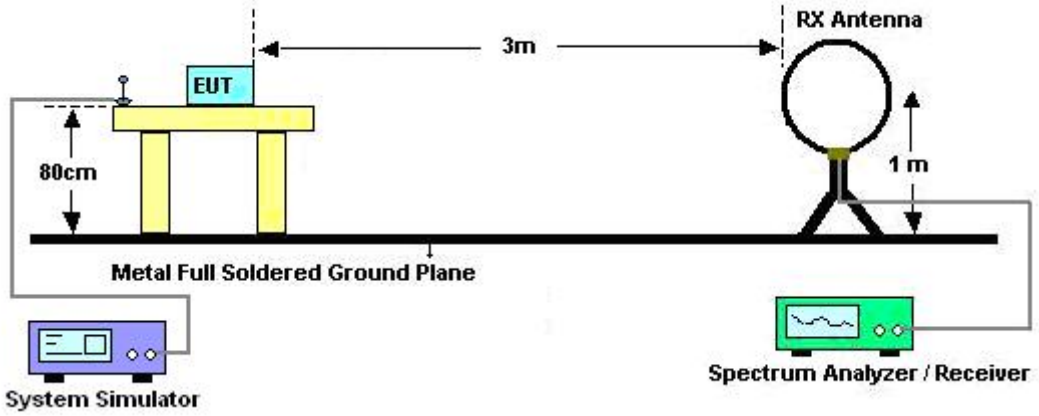
③ When frequency ⩾ 1 GHz:

• Set RBW = 1 MHz; VBW = 3 MHz for peak measurement;

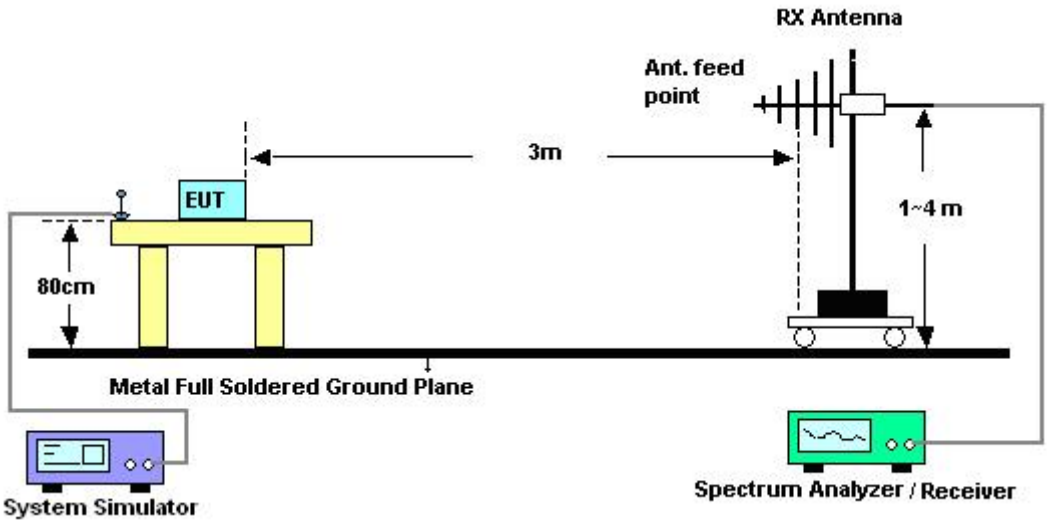
• Set RBW = 1 MHz; VBW = 10 Hz, when duty cycle is no less than 98 percent or VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.7.3. Test Setup

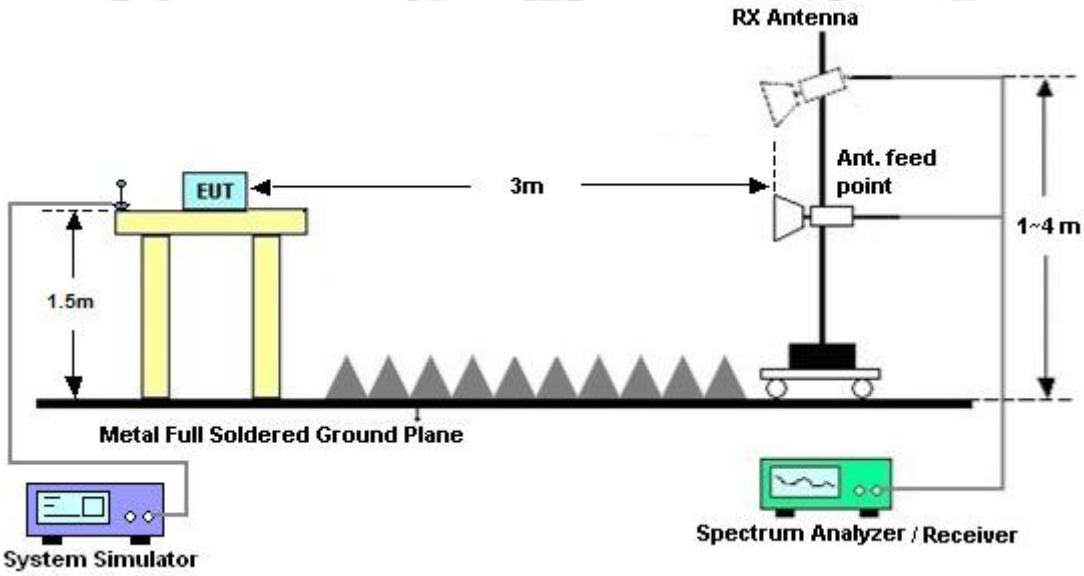
3.7.3.1. For radiated emissions below 30MHz



3.7.3.2. For radiated emissions from 30MHz to 1GHz



3.7.3.3. For radiated emissions above 1GHz



3.7.4. Test Result of Radiated Spurious Emission

3.7.4.1. For 9 kHz ~ 30 MHz

Please refer to the Appendix B.

3.7.4.2. For 30 MHz ~ 1 GHz

Please refer to the Appendix B.

3.7.4.3. For 1 GHz ~ 18GHz

Please refer to the Appendix B.

3.7.4.4. For above 18GHz

Please refer to the Appendix B.

Please refer to the Appendix B.

3.8. AC Power-Line Conducted Emission

3.8.1. Limit

47 CFR 15.207(a): For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table:

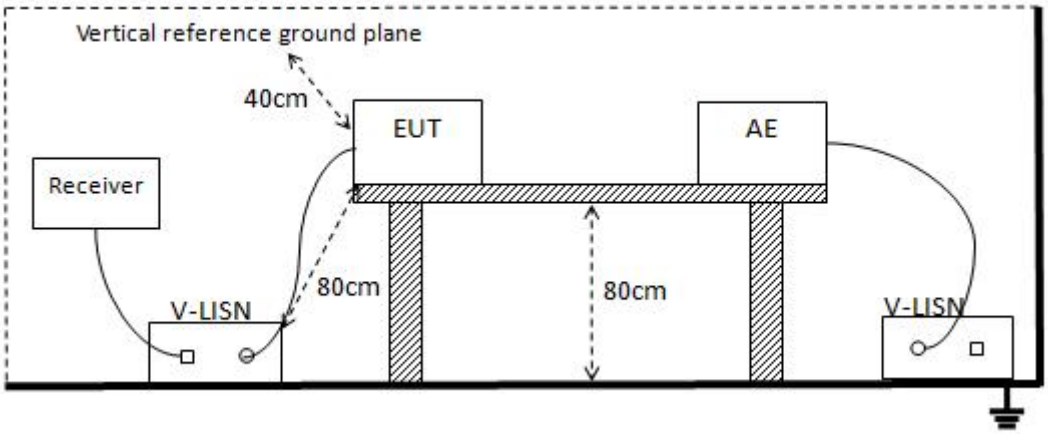
Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

3.8.2. Test Procedure

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9 kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.8.3. Test Setup



3.8.4. Test Result of AC Power-Line Conducted Emission

Please refer to the Appendix C.

3.9. Antenna Requirement

3.9.1. Standard Requirement

According to *47 CFR 15.203*, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

3.9.2. EUT Antenna

The antenna used for the EUT is Onboard antenna, which meets the antenna requirements.

4. Test Setup Photographs

Please refer to the Appendix D.

※※※※※END OF THE REPORT※※※※※

Appendix A _ Conducted Test Data

3.1.4. Test Result of Maximum Peak Conducted Output Power

Temperature:	23.4 ℃	Relative Humidity:	55%RH
Test Voltage:	DC 3V	Test Mode:	TX Mode 1/2/3

Test Channel	Frequency	Average Conducted Output Power	Peak Conducted Output Power	LIMIT
	(MHz)	(dBm)	(dBm)	dBm
Mode1 CH00	2402	-0.82	-0.76	30
Mode2 CH19	2440	-0.70	-0.64	30
Mode3 CH39	2480	-0.49	-0.43	30

EIRP Power

Test Channel	Frequency	Peak Conducted Output Power	Antenna Gain	EIRP Power	LIMIT
	(MHz)	(dBm)	(dBi)	(dBm)	dBm
Mode1 CH00	2402	-0.76	1.8128	1.05	36
Mode2 CH19	2440	-0.64	1.8128	1.17	36
Mode3 CH39	2480	-0.43	1.8128	1.38	36

Note: Our power sensor test AVG power has no duty cycle display. The power sensor measures AVG power is Burst power. The software has considered the factor of the duty cycle factor, so it is unnecessary to add it again.

3.2.4. Test Result of Duty Cycle

Temperature:	23.4 ℃	Relative Humidity:	55%RH
Test Voltage:	DC 3V	Test Mode:	TX Mode 2

BLE -1Mbps

3.3.4. Test Result of 6dB Bandwidth and 99% Bandwidth

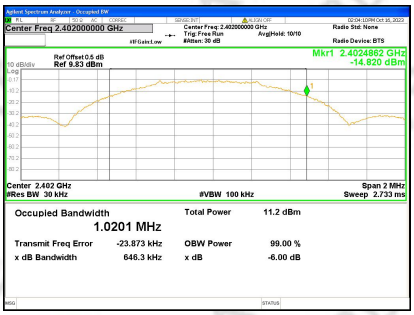
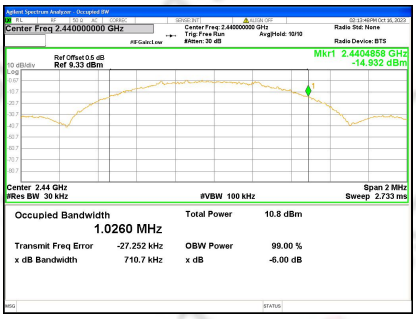
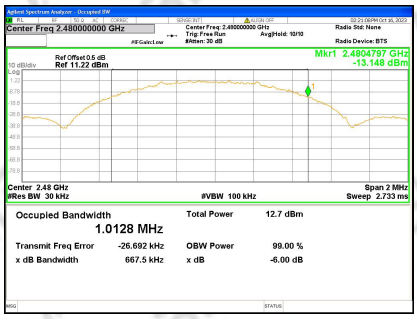
Temperature:	23.4℃	Relative Humidity:	55%RH
Test Voltage:	DC 3V	Test Mode:	TX Mode1/2/3

Frequency		6dB Bandwidth (kHz)	99% Bandwidth (MHz)	6dB Bandwidth Limit(kHz)	Result
1Mbps	2402 MHz	660.0	1.0201	≥500kHz	PASS
	2440 MHz	668.0	1.0260	≥500kHz	PASS
	2480 MHz	662.0	1.0128	≥500kHz	PASS

6dB Bandwidth

6dB Bandwidth Mode1 CH 00	6dB Bandwidth Mode2 CH 19	6dB Bandwidth Mode3 CH 39

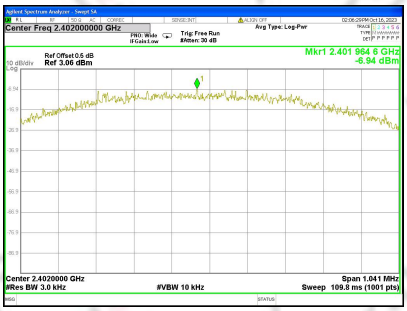
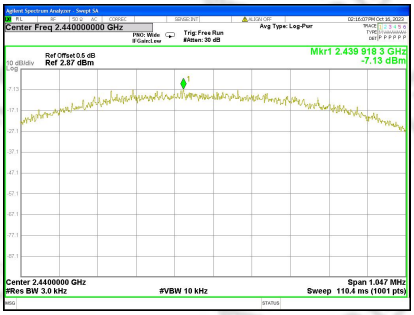
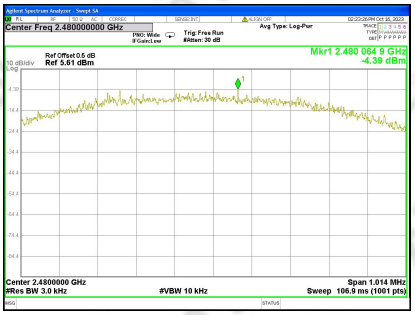
99% Bandwidth

99% Bandwidth Mode1 CH00	99% Bandwidth Mode2 CH19	99% Bandwidth Mode3 CH39
		

3.4.4. Test Result of Power Spectral Density

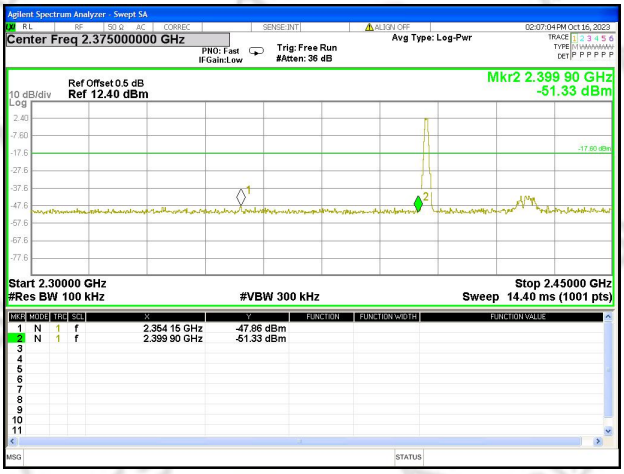
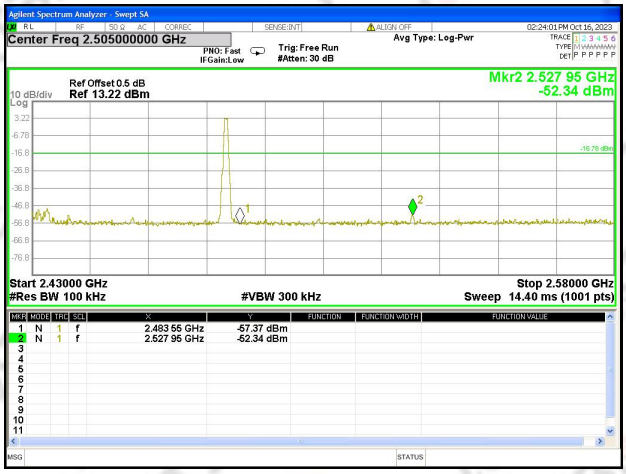
Temperature:	23.4 ℃	Relative Humidity:	55%RH
Test Voltage:	DC 3V	Test Mode:	TX Mode1/2/3

Frequency		Power Density (dBm/3kHz)	Limit (3kHz/dBm)	Result
1M bps	2402 MHz	-6.940	≤8	PASS
	2440 MHz	-7.130	≤8	PASS
	2480 MHz	-4.390	≤8	PASS

Mode1 CH00	Mode2 CH19	Mode3 CH39
		

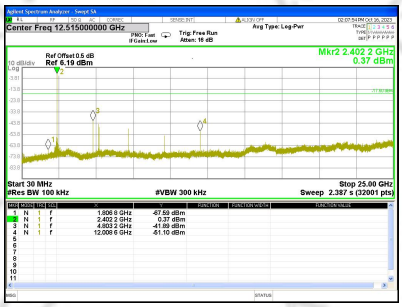
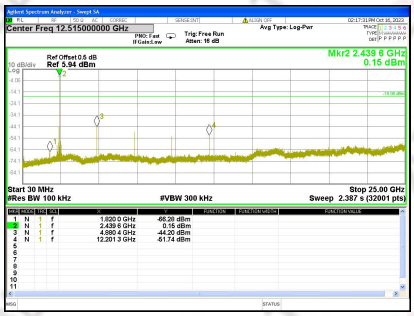
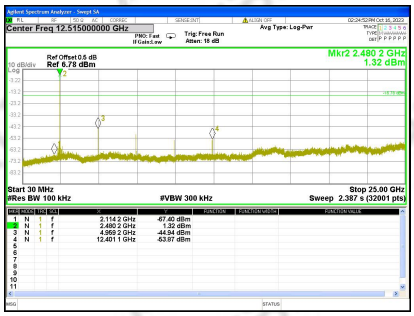
3.5.4. TEST RESULTS of Conducted Band Edge

Temperature:	23.4 °C	Relative Humidity:	55%RH
Test Voltage:	DC 3V	Test Mode:	TX Mode 1/2/3

Mode1 CH00	Mode3 CH39
	

3.6.4. Test Result of Conducted Spurious Emission

Temperature:	23.4 °C	Relative Humidity:	55%RH
Test Voltage:	DC 3V	Test Mode:	TX Mode 1/2/3

Mode1 CH00	Mode2 CH19	Mode3 CH39
		

※※※※※END OF APPENDIX A※※※※※

Appendix B _ Radiated Test Data

3.7.4. Test Result of Radiated Spurious Emission

3.7.4.1. For 9 kHz ~ 30 MHz

(9kHz -30MHz)

Temperature:	23.4℃	Relative Humidity	55%RH
Test Voltage:	DC 3V	Polarization:	
Test Mode:	TX Mode		

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor =40 log (specific distance/test distance)(dB);

Limit line = specific limits(dBuv) + distance extrapolation factor.

3.7.4.2. For 30 MHz ~ 1 GHz

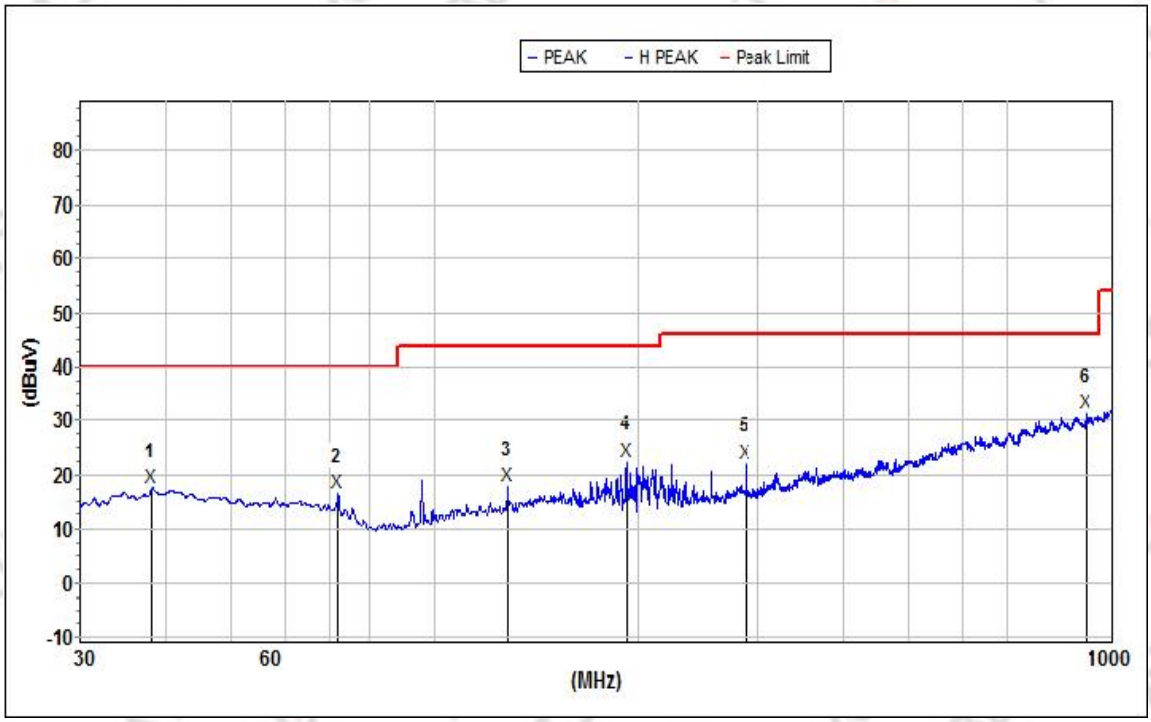
(30MHz -1000MHz)

Temperature:	23.4℃	Relative Humidity:	55%RH
Test Voltage:	DC 5V	Phase:	H
Test Mode:	TX Mode 1		

Remark:

1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

Mode 1 Horizontal



Mk.	Freq. (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Deg. (deg.)	Hi. (cm)	Aux.F. (dB)	Pol.
Peak:								
1	38.212010	17.6	40.0	22.4	0	100	1.1	H
2	72.084342	16.7	40.0	23.3	359	393	1.7	H
3	127.888536	17.8	43.5	25.7	359	200	1.9	H
4	191.745028	22.7	43.5	20.8	322	200	2.2	H
5	287.990423	22.1	46.0	23.9	39	100	3	H
6	912.862050	31.5	46.0	14.5	2	299	4.4	H

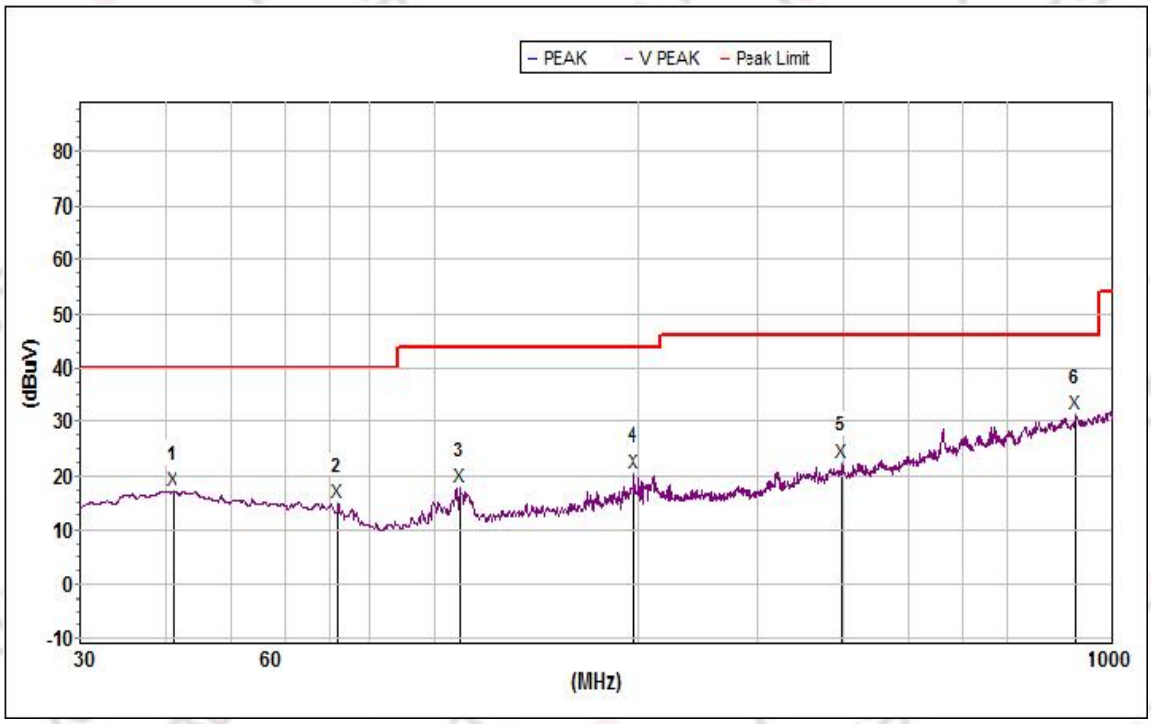
(30MHz -1000MHz)

Temperature:	23.4°C	Relative Humidity:	55%RH
Test Voltage:	DC 5V	Phase:	Vertical
Test Mode:	TX Mode 1		

Remark:

1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

Mode 1 Vertical



Mk.	Freq.(MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Deg. (deg.)	Hi. (cm)	Aux.F. (dB)	Pol.
Peak:								
1	41.132049	17.2	40.0	22.8	109	100	0.9	V
2	72.084342	15.0	40.0	25.0	89	100	1.7	V
3	109.028650	18.0	43.5	25.5	190	201	1.9	V
4	197.200105	20.7	43.5	22.8	358	201	2.2	V
5	398.331204	22.7	46.0	23.3	324	201	2.5	V
6	881.406736	31.4	46.0	14.6	288	201	4.2	V

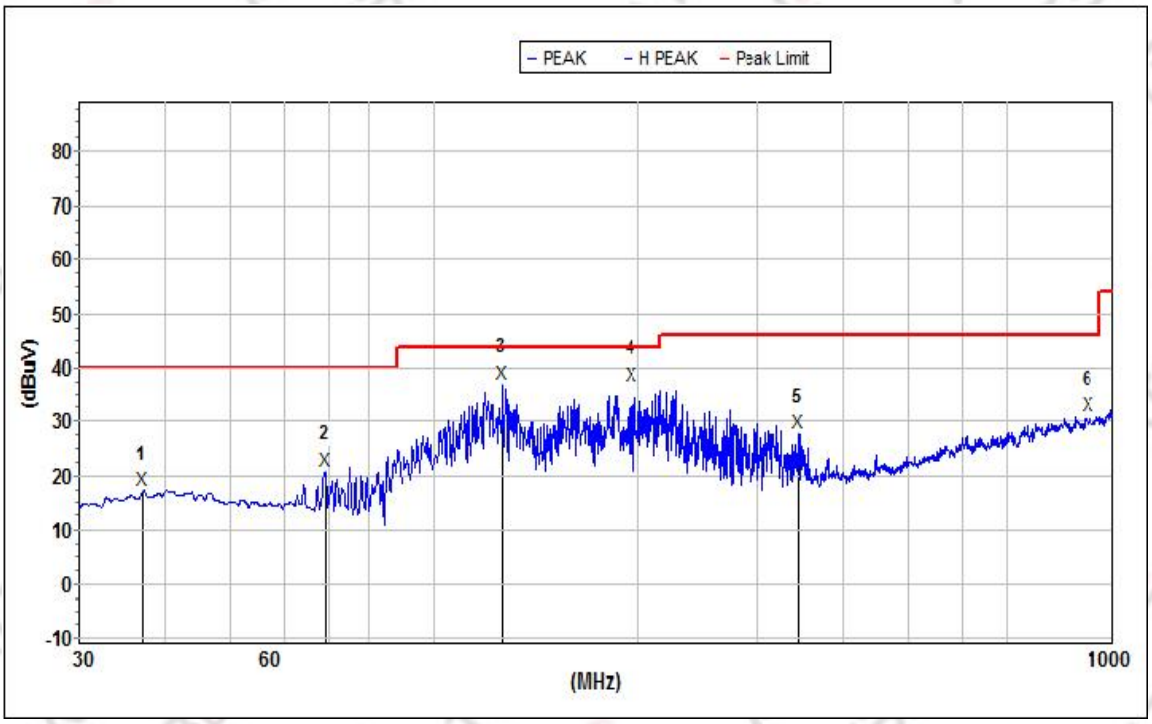
(30MHz -1000MHz)

Temperature:	23.4℃	Relative Humidity:	55%RH
Test Voltage:	DC 5V	Phase:	Horizontal
Test Mode:	TX Mode 3		

Remark:

1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

Mode 3 Horizontal



Mk.	Freq. (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Deg. (deg.)	Hi. (cm)	Aux.F. (dB)	Pol.
Peak:								
1	37.220165	17.4	40.0	22.6	178	200	0.9	H
2	69.235341	20.9	40.0	19.1	0	400	1.7	H
3	125.886356	36.9	43.5	6.6	296	200	1.9	H
4	196.165587	36.7	43.5	6.8	296	200	2.2	H
5	344.989836	27.9	46.0	18.1	360	100	3.0	H
6	924.134595	31.2	46.0	14.8	202	300	4.4	H

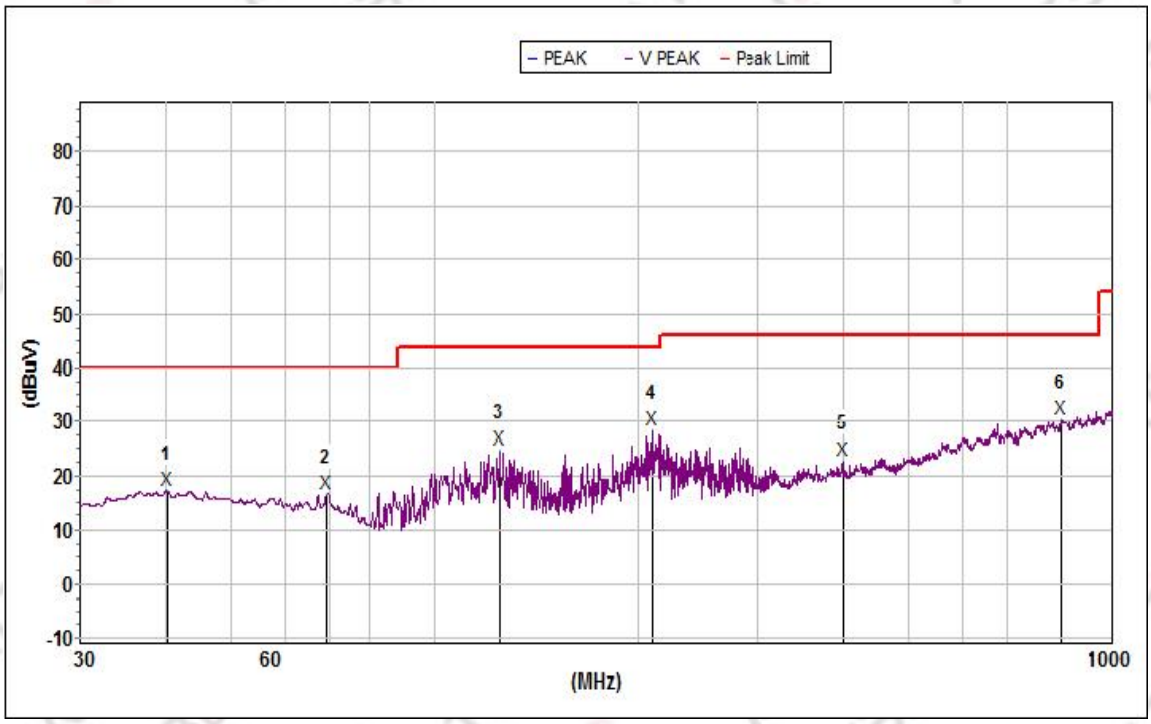
(30MHz -1000MHz)

Temperature:	23.4℃	Relative Humidity:	55%RH
Test Voltage:	DC 5V	Phase:	Vertical
Test Mode:	TX Mode 3		

Remark:

1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

Mode 3 Vertical



Mk.	Freq.(MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Deg. (deg.)	Hi. (cm)	Aux.F. (dB)	Pol.
Peak:								
1	40.134716	17.3	40.0	22.7	46	200	0.8	V
2	69.235341	16.7	40.0	23.3	40	301	1.7	V
3	124.569014	25.0	43.5	18.5	273	301	1.9	V
4	209.680247	28.6	43.5	14.9	0	100	2.5	V
5	399.730428	23.0	46.0	23.0	0	100	3.0	V
6	840.654423	30.6	46.0	15.4	23	301	4.3	V

3.7.4.3. For 1 GHz ~ 18GHz

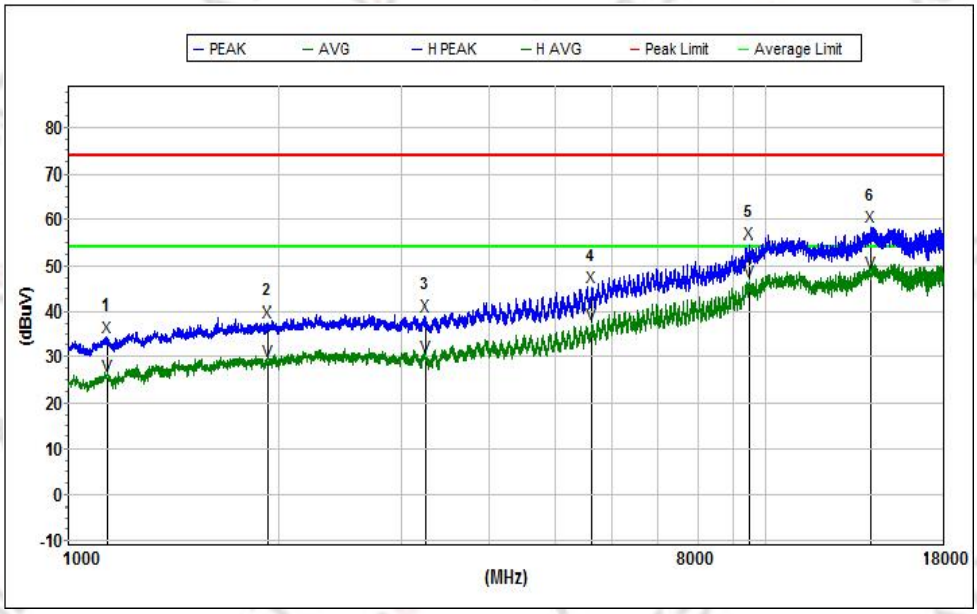
(1000MHz-18000MHz)

Temperature:	22.3℃	Relative Humidity:	51%RH
Test Voltage:	DC 5V	Phase:	Horizontal
Test Mode:	TX Mode		

Remark:

1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

Mode 1 Horizontal



Mk.	Freq.(MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Ant.F/G. (dB)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
Peak:								
1	1135.150000	34.4	74.0	39.6	25.4	59.3	2.2	H
2	1934.150000	37.6	74.0	36.4	25.3	56.4	2.6	H
3	3238.900000	39.1	74.0	34.9	29.1	57.6	3.0	H
4	5630.800000	45.3	74.0	28.7	32.8	57.2	4.0	H
5	9473.650000	54.8	74.0	19.2	38.1	56.9	5.4	H
6	14127.400000	58.4	74.0	15.6	39.8	55.9	6.2	H
Avg								
1	1135.150000	26.0	54.0	28.0	25.4	59.3	2.2	H
2	1934.150000	29.1	54.0	24.9	25.3	56.4	2.6	H
3	3238.900000	30.0	54.0	24.0	29.1	57.6	3.0	H
4	5630.800000	37.3	54.0	16.7	32.8	57.2	4.0	H
5	9473.650000	46.5	54.0	7.5	38.1	56.9	5.4	H
6	14127.400000	48.6	54.0	5.4	39.8	55.9	6.2	H

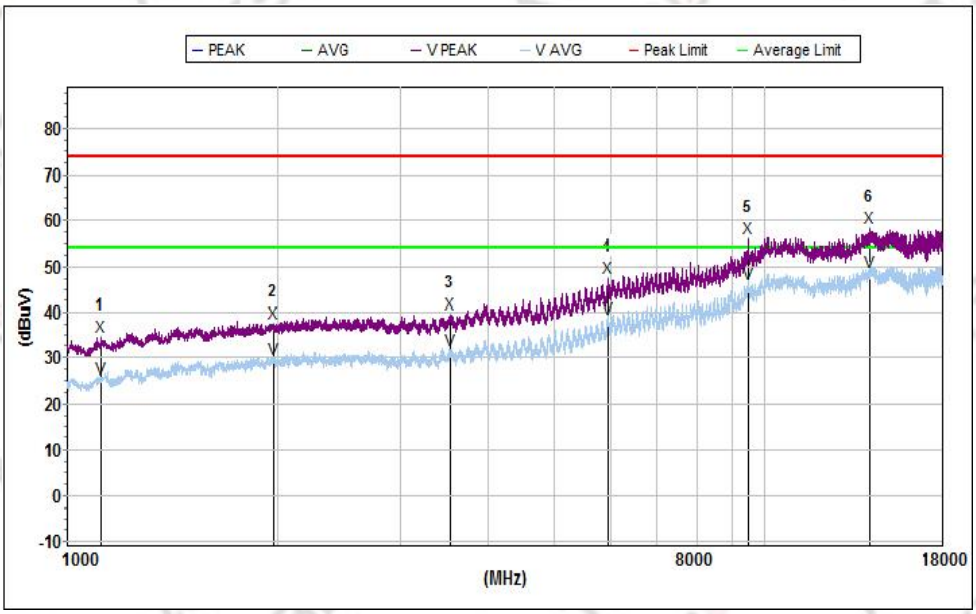
(1000MHz-18000MHz)

Temperature:	22.3℃	Relative Humidity:	51%RH
Test Voltage:	DC 5V	Phase:	Vertical
Test Mode:	TX Mode		

Remark:

3. Margin = Result (Result =Reading + Factor)–Limit
4. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

Mode 1 Vertical



Mk.	Freq.(MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Ant.F/G. (dB)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
Peak:								
1	1117.300000	34.8	74.0	39.2	25.3	59.4	2.2	V
2	1974.100000	37.6	74.0	36.4	25.4	56.3	2.7	V
3	3542.350000	39.7	74.0	34.3	29.2	57.4	3.2	V
4	5948.700000	47.5	74.0	26.5	33.6	57.0	4.1	V
5	9480.450000	56.0	74.0	18.0	37.8	56.9	5.4	V
6	14163.950000	58.5	74.0	15.5	39.7	55.9	6.2	V
Avg								
1	1117.300000	25.6	54.0	28.4	25.3	59.4	2.2	V
2	1974.100000	29.8	54.0	24.2	25.4	56.3	2.7	V
3	3542.350000	31.6	54.0	22.4	29.2	57.4	3.2	V
4	5948.700000	38.7	54.0	15.3	33.6	57.0	4.1	V
5	9480.450000	46.4	54.0	7.6	37.8	56.9	5.4	V
6	14163.950000	48.8	54.0	5.2	39.7	55.9	6.2	V

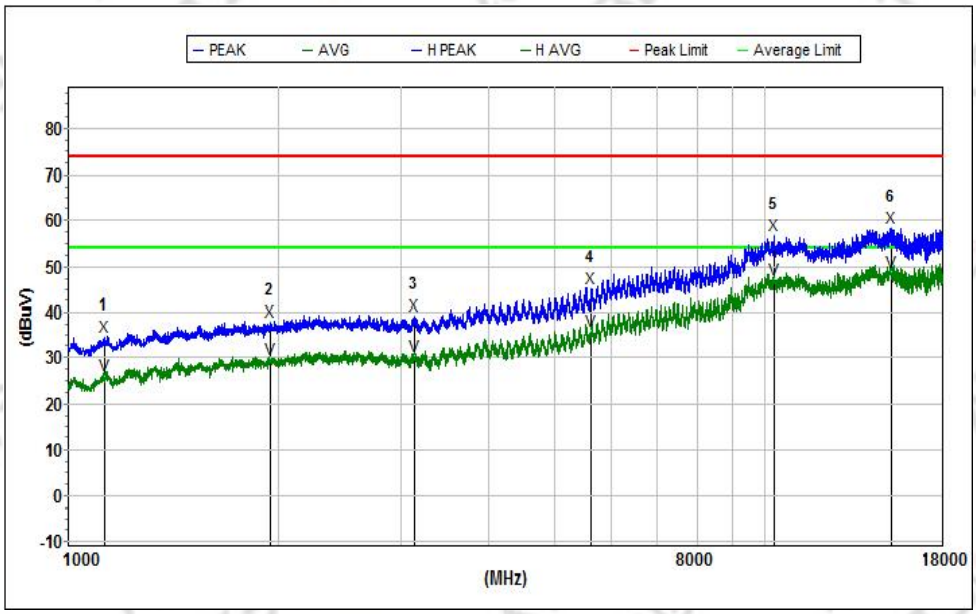
(1000MHz -18000MHz)

Temperature:	23.4℃	Relative Humidity:	55%RH
Test Voltage:	DC 5V	Phase:	Horizontal
Test Mode:	TX Mode 3		

Remark:

1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

Mode 3 Horizontal



Mk.	Freq.(MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Ant.F/G. (dB)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
Peak:								
1	1126.650000	34.8	74.0	39.2	25.4	59.3	2.2	H
2	1950.300000	38.1	74.0	35.9	25.3	56.3	2.7	H
3	3133.500000	39.2	74.0	34.8	29.0	57.7	3.0	H
4	5629.950000	45.2	74.0	28.8	32.7	57.2	4.0	H
5	10287.100000	56.6	74.0	17.4	38.4	56.6	5.5	H
6	15180.550000	58.3	74.0	15.7	38.8	55.9	6.4	H
Avg								
1	1126.650000	26.2	54.0	27.8	25.4	59.3	2.2	H
2	1950.300000	29.7	54.0	24.3	25.3	56.3	2.7	H
3	3133.500000	30.3	54.0	23.7	29.0	57.7	3.0	H
4	5629.950000	36.1	54.0	17.9	32.7	57.2	4.0	H
5	10287.100000	47.3	54.0	6.7	38.4	56.6	5.5	H
6	15180.550000	48.8	54.0	5.2	38.8	55.9	6.4	H

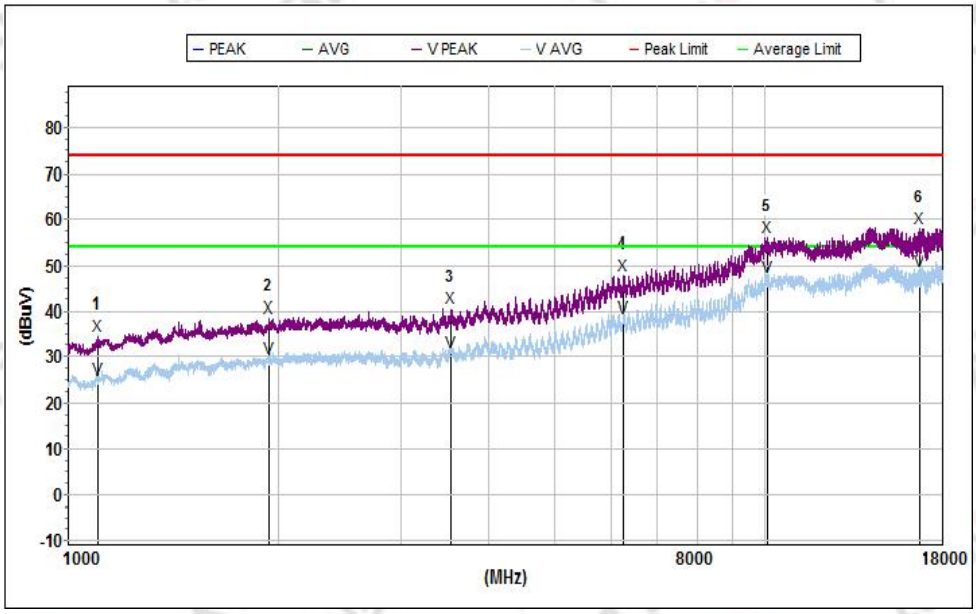
(1000MHz -18000MHz)

Temperature:	25.3℃	Relative Humidity:	52%RH
Test Voltage:	DC 5V	Phase:	Vertical
Test Mode:	TX Mode 3		

Remark:

1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

Mode 3 Vertical



Mk.	Freq.(MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Ant.F/G. (dB)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
Peak:								
1	1100.300000	34.6	74.0	39.4	25.3	59.5	2.2	V
2	1942.650000	38.7	74.0	35.3	25.4	56.4	2.6	V
3	3550.850000	40.7	74.0	33.3	29.2	57.5	3.2	V
4	6244.500000	47.8	74.0	26.2	34.2	57.0	4.2	V
5	10096.700000	56.2	74.0	17.8	38.2	56.5	5.4	V
6	16653.600000	58.1	74.0	15.9	37.9	56.1	6.8	V
Avg								
1	1100.300000	25.1	54.0	28.9	25.3	59.5	2.2	V
2	1942.650000	29.7	54.0	24.3	25.4	56.4	2.6	V
3	3550.850000	31.0	54.0	23.0	29.2	57.5	3.2	V
4	6244.500000	38.7	54.0	15.3	34.2	57.0	4.2	V
5	10096.700000	47.6	54.0	6.4	38.2	56.5	5.4	V
6	16653.600000	48.8	54.0	5.2	37.9	56.1	6.8	V

Note:

1. All TX Mode, the worst case is mode1&3, only show the worst case.

3.7.4.4. For above 18GHz

(above 18GHz)

Temperature:	22.3°C	Relative Humidity:	51%
Test Voltage:	DC 3.7V	Test Mode:	TX Mode

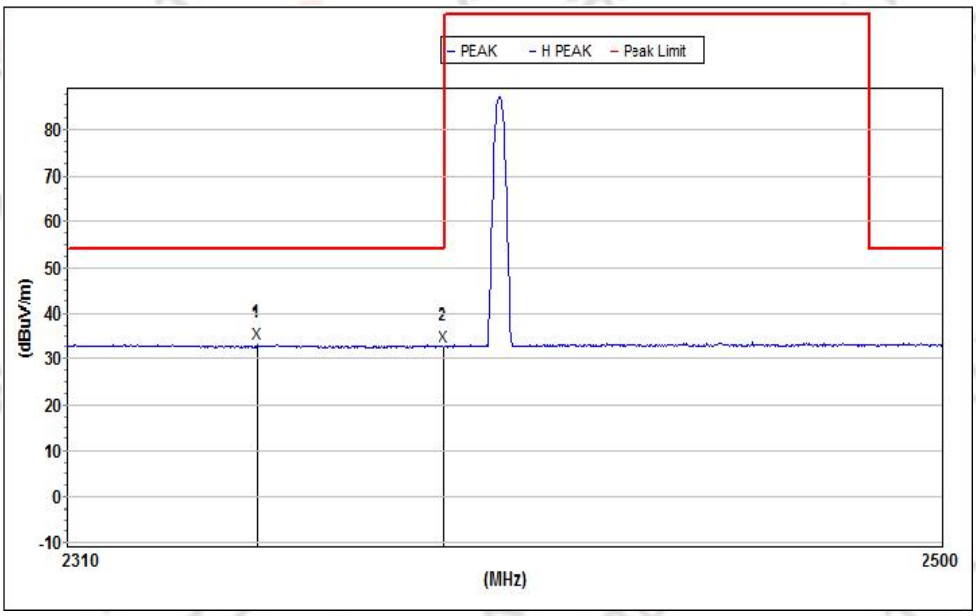
Note:

1. Other 18G-25G Emission detected are more than 20dB below the limit.

3.7.5 Test Result of Restricted Band

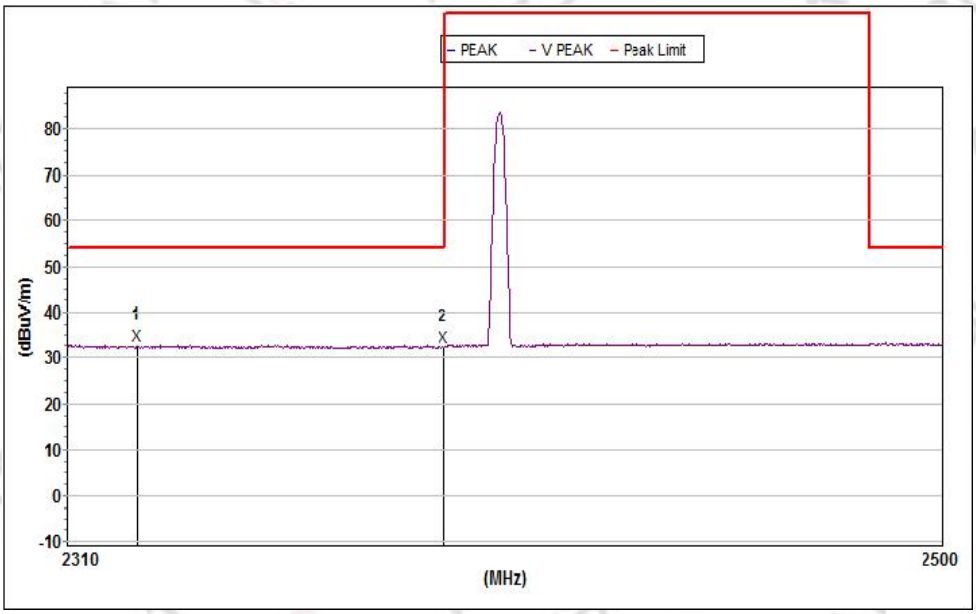
GFSK-Low

Mode 1 Horizontal



Mk.	Frequency	Level	Limit	Margin	Ant.F/G.	Amp.G.	Cbl.L.	Pol.
	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(dB)	(dB)	
Avg								
1	2350.149501	33.3	54.0	20.7	27.3	56.7	6.8	H
2	2390.000000	32.6	54.0	21.4	27.4	56.9	6.8	H

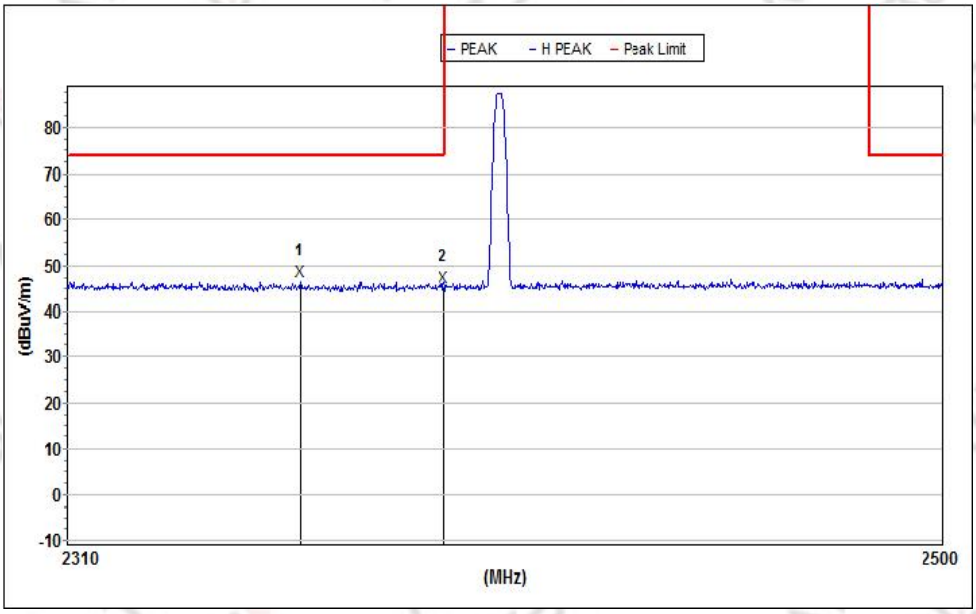
Mode 1 Vertical



Mk.	Frequency	Level	Limit	Margin	Ant.F/G.	Amp.G.	Cbl.L.	Pol.
	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(dB)	(dB)	
Avg								
1	2324.469725	32.6	54.0	21.4	26.7	56.6	6.7	V
2	2390.000000	32.4	54.0	21.6	27.1	56.9	6.8	V

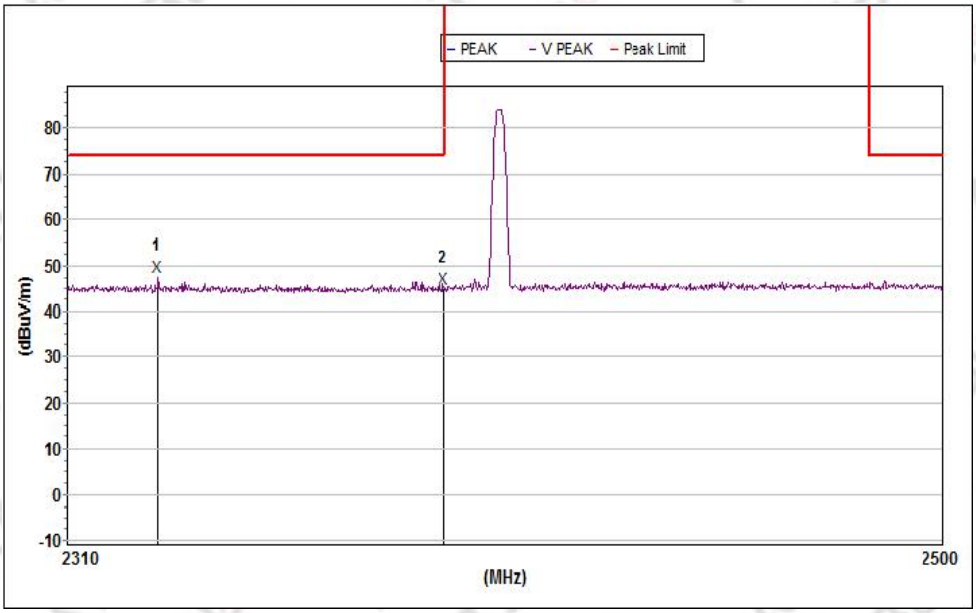
GFSK-Low

Mode 1 Horizontal



Mk.	Frequency	Level	Limit	Margin	Ant.F/G.	Amp.G.	Cbl.L.	Pol.
	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(dB)	(dB)	
Peak:								
1	2359.083079	46.7	74.0	27.3	27.3	56.7	6.8	H
2	2390.000000	45.1	74.0	28.9	27.4	56.9	6.8	H

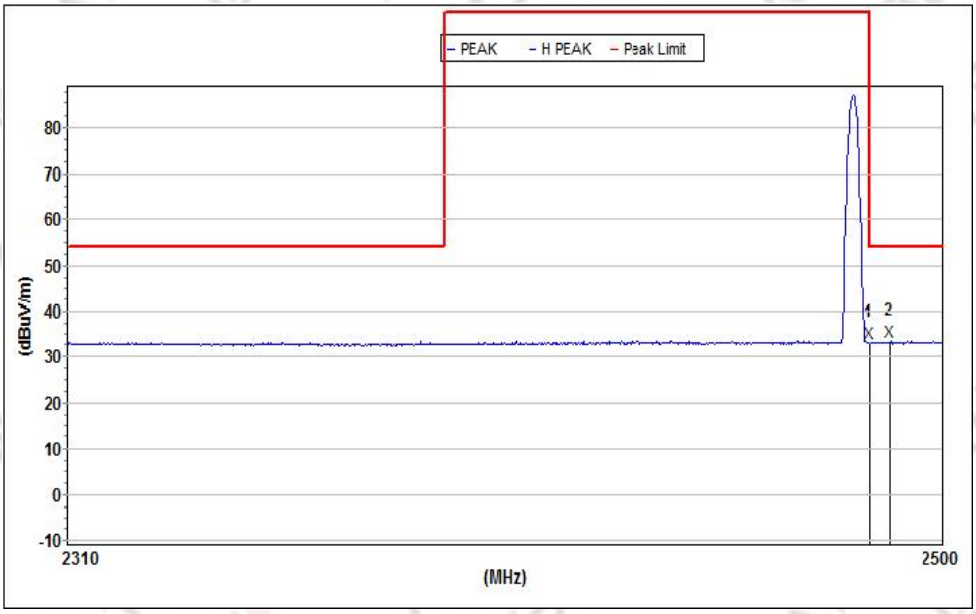
Mode 1 Vertical



Mk.	Frequency	Level	Limit	Margin	Ant.F/G.	Amp.G.	Cbl.L.	Pol.
	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(dB)	(dB)	
Peak:								
1	2329.067605	47.5	74.0	26.5	26.7	56.6	6.7	V
2	2390.000000	45.0	74.0	29.0	27.1	56.9	6.8	V

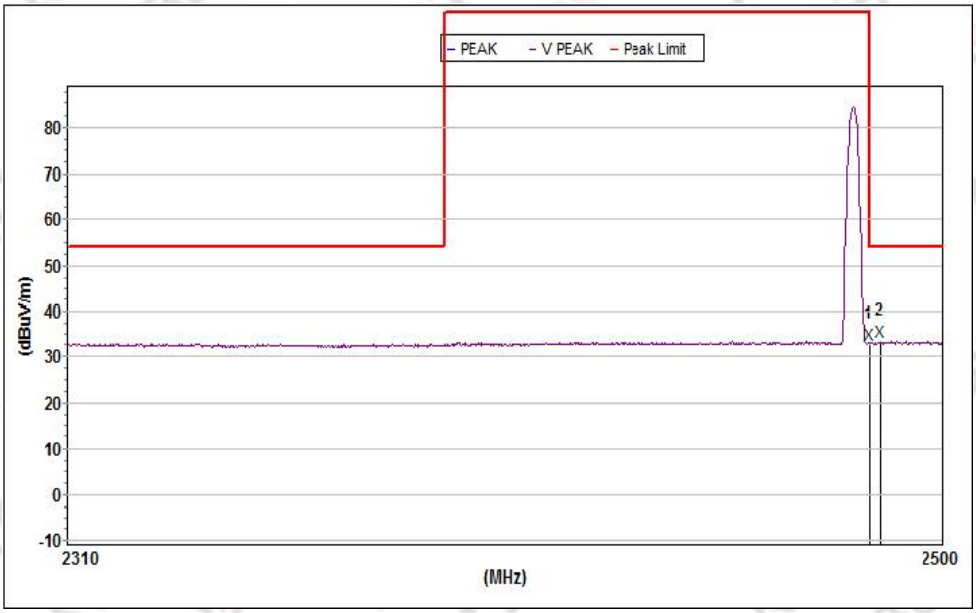
GFSK-High

Mode 3 Horizontal



Mk.	Frequency	Level	Limit	Margin	Ant.F/G.	Amp.G.	Cbl.L.	Pol.
	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(dB)	(dB)	
Avg								
1	2483.501000	33.0	54.0	21.0	27.6	57.1	6.9	H
2	2487.974924	33.4	54.0	20.6	27.6	57.1	6.9	H

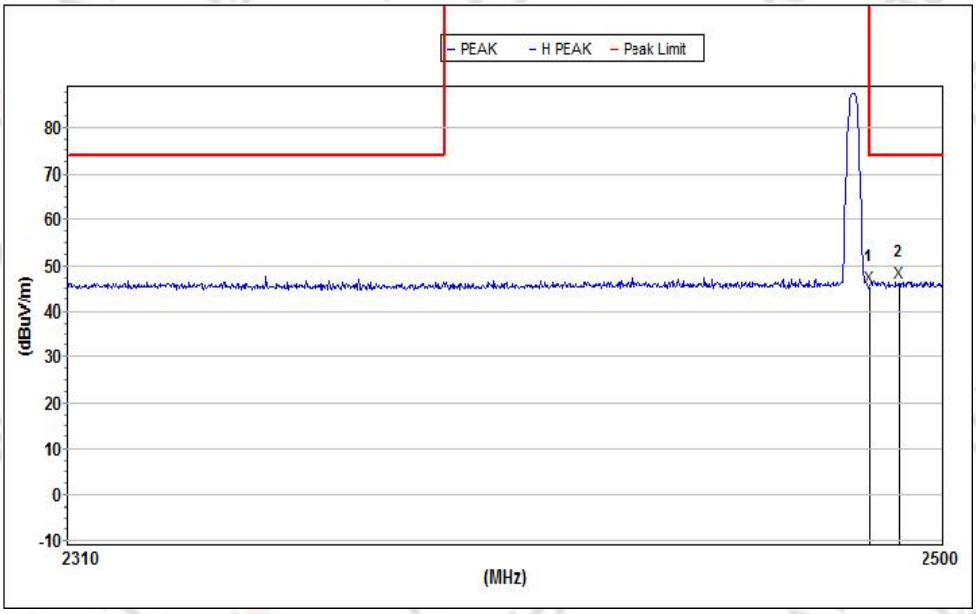
Mode 3 Vertical



Mk.	Frequency	Level	Limit	Margin	Ant.F/G.	Amp.G.	Cbl.L.	Pol.
	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(dB)	(dB)	
Avg								
1	2483.501000	32.9	54.0	21.1	27.4	57.1	6.9	V
2	2486.009126	33.3	54.0	20.7	27.4	57.1	6.9	V

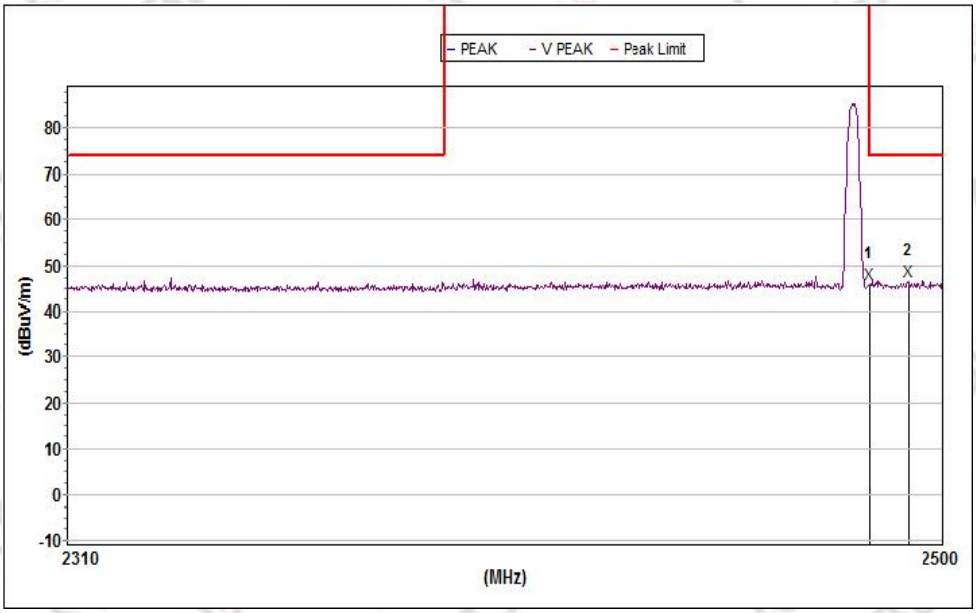
GFSK- High

Mode 3 Horizontal



Mk.	Frequency	Level	Limit	Margin	Ant.F/G.	Amp.G.	Cbl.L.	Pol.
	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(dB)	(dB)	
Peak:								
1	2483.501000	45.3	74.0	28.7	27.6	57.1	6.9	H
2	2490.139098	46.4	74.0	27.6	27.6	57.1	6.9	H

Mode 3 Vertical



Mk.	Frequency	Level	Limit	Margin	Ant.F/G.	Amp.G.	Cbl.L.	Pol.
	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(dB)	(dB)	
Peak:								
1	2483.501000	45.8	74.0	28.2	27.4	57.1	6.9	V
2	2492.108162	46.7	74.0	27.3	27.4	57.1	6.9	V

Note：All TX Mode, the worst case is mode1&3, only show the worst case.

※※※※※END OF APPENDIX B※※※※※

Appendix C _ AC Power-Line Conducted Emission Test Data

3.8.4. Test Result of AC Power-Line Conducted Emission

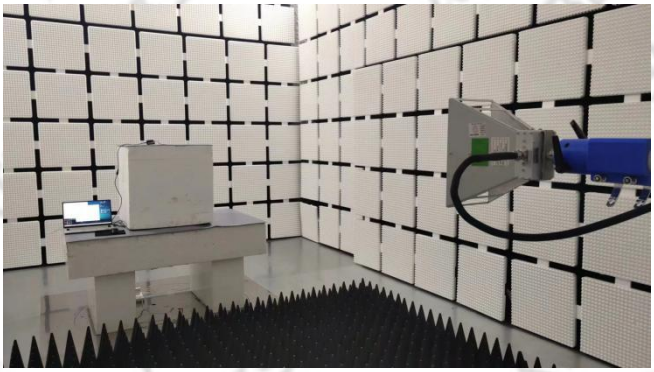
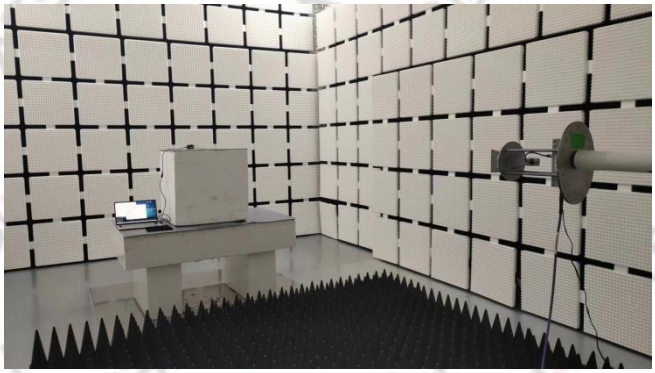
Temperature:	23.4℃	Relative Humidity:	55%RH
Test Voltage:	AC 120V/60Hz	Phase:	L
Test Mode:	Mode 4		

Note: This EUT is powered by dry batteries, so this test is not required.

※※※※※END OF APPENDIX C※※※※※

Appendix D _ Test Setup

4. TEST SETUP PHOTOGRAPHS

Radiated Emissions for 30MHz~1GHz	Radiated Emissions for 1GHz~18GHz
	
Radiated Emissions for 9kHz~30MHz	**Conducted for RF**
Radiated Emissions for above 18GHz	**AC Power Line Conducted Emissions**
	N/A

※※※※※END OF APPENDIX D※※※※※